PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : C25B 9/00, H01M 8/02, 8/24

A2

(11) International Publication Number: WO 00/39362

(43) International Publication Date: 6 July 2000 (06.07.00)

(21) International Application Number: PCT/US99/26509

(22) International Filing Date: 11 November 1999 (11.11.99)

(30) Priority Data:

60/114,559	31 December 1998 (31.12.98)	US
09/413,782	7 October 1999 (07.10.99)	US

(71) Applicant: PROTON ENERGY SYSTEMS, INC. [US/US]; 50 Inwood Road, Rocky Hill, CT 06067 (US).

(72) Inventors: SHIEPE, Jason, K.; 90 Ridgefield Drive, Middletown, CT 06457 (US). DRISTY, Mark, E.; Apartment 107, 141 John Olds Drive, Manchester, CT 06040 (US). MOLTER, Trent, M.; 14 Harvest Lane, Glastonbury, CT 06033 (US). MOULTHROP, Lawrence, C., Jr.; 244 Carriage Way, Windsor, CT 06095 (US).

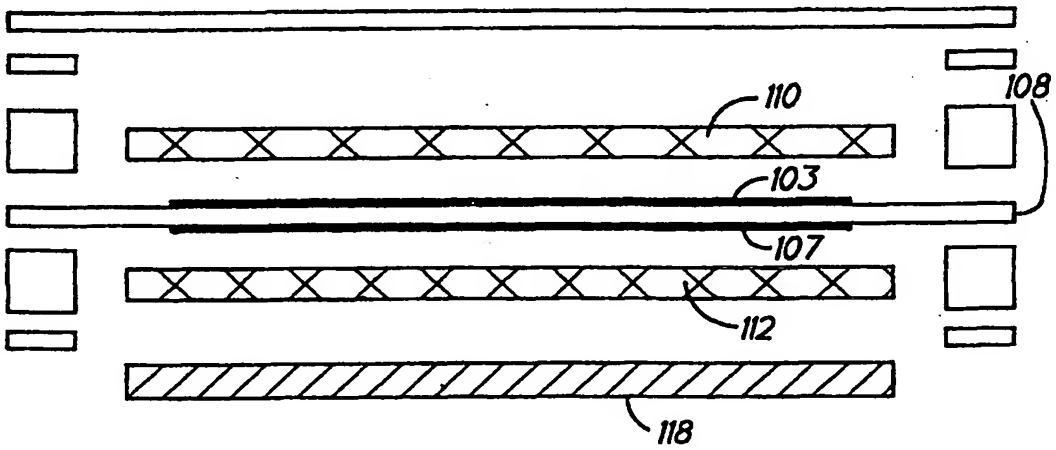
(74) Agent: CURBELO, Pamela, J.; Cantor Colburn LLP, 88 Day Hill Road, Windsor, CT 06095 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

Without international search report and to be republished upon receipt of that report.

(54) Title: MEANS OF MAINTAINING COMPRESSION OF THE ACTIVE AREA IN AN ELECTROCHEMICAL CELL



(57) Abstract

The present invention relates to a unique electrochemical cell stack which employs an electrically conductive pressure pad. The pressure pad is composed of material compatible with the electrochemical cell environment and is disposed on the high pressure side of the membrane assembly, in intimate contact with the high pressure side screen pack.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

MEANS OF MAINTAINING COMPRESSION OF THE ACTIVE AREA IN AN ELECTROCHEMICAL CELL

TECHNICAL FIELD

The present invention relates to a means of maintaining compression within the active area of an electrochemical cell, and especially relates to the use of a pressure pad assembly to maintain compression within the active area on the high pressure side of an electrochemical cell.

BACKGROUND OF THE INVENTION

Electrochemical cells are energy conversion devices, usually classified as either electrolysis cells or fuel cells. A proton exchange membrane electrolysis cell functions as a hydrogen generator by electrolytically decomposing water to produce hydrogen and oxygen gases. Referring to FIGURE 1, in a typical single anode feed water electrolysis cell 101, process water 102 is reacted at oxygen electrode (anode) 103 to form oxygen gas 104, electrons, and hydrogen ions (protons) 105. The reaction is created by the positive terminal of a power source 106 electrically connected to anode 103 and the negative terminal of a power source 106 connected to hydrogen electrode (cathode) 107. The oxygen gas 104 and a portion of the process water 102' exit cell 101, while protons 105 and water 102" migrate across proton exchange membrane 108 to cathode 107 where hydrogen gas 109, is formed.

The typical electrochemical cell includes a number of individual cells arranged in a stack with fluid, typically water, forced through the cells at high pressures. The cells within the stack are sequentially arranged including a cathode, a proton exchange membrane, and an anode. The cathode/membrane/anode assemblies (hereinafter "membrane assembly") are supported on either side by packs of screen or expanded metal which are in turn surrounded by cell frames and separator plates to form reaction chambers and to seal fluids therein. The screen packs establish flow fields within the reaction chambers to facilitate fluid movement and membrane hydration, and to provide mechanical support for the membrane and a means of transporting electrons to and from electrodes.

In order to maintain uniform compression in the cell active area, i.e., the electrodes, thereby maintaining intimate contact between flow fields and cell electrodes over long time periods, pressure pads have traditionally been used within electrochemical cells. Pressure pads have traditionally been fabricated from materials incompatible with systems fluids and/or the cell membrane, such as silicone rubber, thereby requiring that these pressure pads be disposed within a protective encasing.

Pressure pads are typically preloaded to stress levels which counteract those resulting from the pressurization levels of the working fluids of the electrochemical cell plus approximately 50 p.s.i. to guarantee contact between the cell parts. For example, in an electrolyzer which operates at about 400 p.s.i., the pressure pad is designed to handle 650 p.s.i., which constitutes the proof pressure of the unit (1.5 times the working pressure) plus 50 p.s.i. Typically, during operation, these pads are maintained at a compression stress level of from 50 to about 500 p.s.i. Unfortunately, the elastomer materials typically used for the pressure pad take a compression set and chemically break down when compressed to the higher stress levels.

What is needed in the art is an improved pressure pad which maintains uniform compression, can be utilized at pressures exceeding 2,000 p.s.i. and which is compatible with the electrochemical cell environment.

SUMMARY OF THE INVENTION

The present invention relates to a unique electrochemical cell comprising: an anode; a cathode; a membrane disposed between said anode and said cathode; an anode screen pack located adjacent to and in intimate contact with said anode; a cathode screen pack located adjacent to and in intimate contact with said cathode; and an electrically conductive pressure pad located adjacent to and in intimate contact with a side of said cathode screen pack opposite said cathode.

The above discussed and other features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, which are meant to be exemplary not limiting, and wherein like elements are numbered alike in the several FIGURES:

FIGURE 1 is a schematic diagram of a prior art electrochemical cell showing an electrochemical reaction;

FIGURE 2 is a schematic diagram of a prior art electrochemical cell showing a conventional pressure pad and its location; and

FIGURE 3 is a schematic diagram of the electrochemical cell of the present invention showing the pressure pad and its location.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention relates to a unique pressure pad and its use within an electrochemical cell. This pressure pad, unlike prior art pressure pads, can be utilized on the high pressure side of the electrochemical cell in intimate contact with the screen pack thereof, or as a replacement therefore.

The pressure pad of the present invention comprises a support material and an electrically conductive material which is compatible with the electrochemical cell environment. Preferably, this pressure pad has a size (especially a diameter) and geometry substantially similar to that of the screen pack. Possible elastomeric materials include, but are not limited to silicones, such as fluorosilicones,

fluoroelastomers, such as Kalrez ® (commercially available from Dupont de Nemours, Wilmington, DE), Viton® (commercially available from Dupont de Nemours), and Fluorel® (commercially available from 3M, Michigan); combinations and mixtures thereof, among other elastomers, with fluoroelastomers preferred.

Possible electrically conductive materials which can be utilized in this invention include, but are not limited to, steels, such as stainless steel, nickel, cobalt, carbon, precious metals, and refractory metals, among others and mixtures and alloys thereof. The type, size, and geometry of the electrically conductive material are based upon the need to conduct current from one side of the pressure pad to the other. Consequently, any material geometry capable of conducting such electrical current can be utilized. Particles, clothes (woven and nonwoven), fibers (random and preformed) or other continuous pieces or strips can be used, with, in one embodiment, fibers or other continuous pieces preferred due to the requirements of a relatively high pressure to create an electrical pad when employing particulate.

For example, strips of steel or carbon fibers can be woven into elastomeric material to form the pressure pad. The steel strips or carbon fibers may be interwoven with elastomeric strips or fibers, or stitched directly into an elastomeric substrate. In another example, carbon fibers and Viton cord can be woven together to form the pressure pad; where Viton cord can be directly woven into a carbon cloth substrate, or the Viton cord and carbon fibers can be woven together.

The pressure pad is disposed in intimate contact with the high pressure flow field, which may be a screen pack. The cathode screen pack as well as the anode screen pack can be any conventional screen capable of supporting the membrane, allowing the passage of hydrogen gas and water, and oxygen gas and water, respectively, and of passing electrical current. Typically the screens are composed of layers of perforated sheets or a woven mesh formed from metal or strands. These screens are typically composed of material such as niobium, zirconium, tantalum, titanium, steels, such as stainless steel, nickel, and cobalt, among others and alloys thereof. The geometry of the openings in the screens can range from ovals, circles and hexagons to diamonds and other elongated shapes. An especially preferred screen assembly for use in electrochemical cells is disclosed in commonly assigned U.S.

Patent Serial No. 09/102,305 to Trent M. Molter, Attorney Docket No. 97-1801 (herein incorporated by reference).

The screen assembly supports a membrane assembly composed of a cathode/membrane/anode arrangement wherein the cathode and anode are disposed in intimate contact with the membrane and the screened assemblies are disposed in intimate contact with the cathode and anode accordingly. The membrane can be any conventional membrane including, but not limited to, proton exchange membranes including homogeneous perfluoroionomers such as Nafion® (commercially available from E.I. duPont de Nemours and Company, Wilmington, DE), ionomer Teflon® composites such as Gore Select® (commercially available from W.L. Gore Associates, Inc., Elkton, MD), styrene, such as sulfonated styrene, benzene such as divinyl benzene, and mixtures thereof. Similarly, the cathode and anode electrodes can be conventional electrodes composed of materials such as platinum, palladium, rhodium, carbon, gold, tantalum, tungsten, ruthenium, iridium, osmium, alloys thereof and other catalysts capable of electrolyzing water and producing hydrogen.

Referring to FIGURES 2 and 3, FIGURE 2 shows a typical electrochemical cell having an anode 103, cathode 107, membrane 108, low pressure flow field 110, high pressure flow field 112, high pressure separator plate 114, pressure pad 116. Meanwhile, FIGURE 3 illustrates one embodiment of the electrochemical cell of present invention having an anode 103, cathode 107, membrane 108, low pressure flow field 110, high pressure flow field 112, and an electrically conductive pressure pad 118.

In a water electrolysis cell having an active area of 0.1 square feet (ft^2) and constructed in accordance with FIGURE 3, for example, water at a pressure of 10 p.s.i. was passed across the anode electrode by means of a low pressure flow field chamber. A voltage of approximately 2 volts was applied to the cell while 100 amperes of direct current (DC) were directed through the cell. The Viton® pressure pad assembly was mechanically loaded to 50 p.s.i., and hydrogen gas was produced at a pressure of 150 p.s.i.

In another embodiment of the present invention, a high pressure fluid, such as water (under pressure up to or exceeding about 100 p.s.i., 500 p.s.i., 1,000 p.s.i., or even 2,500 p.s.i.), can be introduced to the high pressure side of the electrochemical cell which has a high pressure flow field disposed in intimate contact with an electrically conductive pressure pad of the present invention. The water passes through the high pressure flow field, migrates from the high pressure electrode, across the membrane, to the low pressure electrode where ions are formed. The ions migrate back across the membrane to the high pressure electrode where a second high pressure fluid is formed, such as hydrogen. The high pressure fluid then passes through the high pressure flow field.

In yet another embodiment of the present invention, a high pressure fluid (again under pressure up to or exceeding about 100 p.s.i., 500 p.s.i., 1,000 p.s.i., or even 2,500 p.s.i.), can be introduced to the high pressure side of the electrochemical cell which has a high pressure flow field disposed in intimate contact with an electrically conductive pressure pad of the present invention. The high pressure fluid is reacted on an electrode adjacent to and in fluid communication with the high pressure flow field to form ions which migrate across a membrane to a low pressure electrode. At the low pressure electrode a low pressure fluid is formed. This low pressure fluid then passes through a low pressure flow field.

Another embodiment of the present invention comprises introducing a low pressure fluid to a low pressure flow field where the low pressure fluid reacts on an electrode adjacent to and in fluid communication with the low pressure flow field to form ions which migrate across a membrane to a high pressure electrode. At the high pressure electrode, high pressure fluid is formed. The high pressure fluid then passes through a high pressure flow field disposed in intimate contact with the electrically conductive pressure pad of the present invention. The pressure of the high pressure fluid formed can have pressures of up to 400, 1,000, or 2,500 p.s.i, or greater, depending upon the system capabilities.

A further embodiment of the present invention comprises a pressure pad having a porosity gradient. This gradient not only improves fluid distribution to the membrane, but it also lowers the voltage required for the electrochemical reaction,

and provides structural integrity to the membrane and electrode assembly, which can eliminate the need for a screen pack. The interwoven elastomer and conductive material can be layered such that the screen pack support is enhanced or replaced, and a gradient of porosity is formed. For example, layers of progressively more tightly woven pressure pad material can be layered to form a gradient. In this example, the layered pressure pad is oriented with the gradient facing either towards or away from the membrane, and located on either side of the membrane. In this configuration, the pressure pads serve not only as the means for ensuring the positive contact of the cell components, but also as the primary means of membrane support.

The electrochemical cell of the present invention utilizes pressure pads which are compatible with the electrochemical cell environment, are utilized in a unique fashion by placing them on the cathode side of the cell thereby only requiring the pads to be compressed to approximately 50 p.s.i., while being capable of withstanding pressures exceeding 2,000 p.s.i., and even exceeding 5,000 p.s.i., with the upper pressure limit controlled by the system capabilities. Further advantages of the present invention include lower electrical resistance thereby leading to higher current densities, simplicity of assembly and preparation, and lower cell voltage due to elimination of screen layers and the pressure pad cavity used with prior art pressure pads in order to protect them. Finally, due to the fewer parts, the electrochemical cell of the present invention is lower cost and has a higher reliability.

While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

What is claimed is:

CLAIM 1. An electrochemical cell, comprising:

a) a high pressure side electrode;

b) a low pressure side electrode;

c) a membrane disposed between and in intimate contact with said high pressure side electrode and said low pressure side electrode;

d) a low pressure flow field;

e) a high pressure flow field; and

f) an electrically conductive pressure pad located adjacent to and in intimate contact with said high pressure flow field.

CLAIM 2. An electrochemical cell as in Claim 1, wherein said pressure pad maintains substantially uniform pressure on said high pressure flow field.

CLAIM 3. An electrochemical cell as in Claim 1, wherein said pressure pad is compatible with the electrochemical cell and can function in pressures exceeding 2,000 p.s.i.

CLAIM 4. An electrochemical cell as in any of Claims 1-3, wherein said pressure pad is compatible with the electrochemical cell and can function in pressures exceeding 5,000 p.s.i.

CLAIM 5. An electrochemical cell as in any of Claims 1-4, wherein said pressure pad comprises one or more layers of conductive material interwoven with an elastomer, said layers each having a porosity.

CLAIM 6. An electrochemical cell as in any of Claims 1-5, wherein said electrically conductive material is a steel, a nickel, cobalt, carbon, refractory metal, precious metal, carbon or a mixture or alloy thereof.

CLAIM 7. An electrochemical cell as in any of Claims 1-6, wherein said pressure pad comprises a fluorosilicone, fluoroelastomer, or combinations thereof.

CLAIM 8. An electrochemical cell as in any of Claims 1-7, wherein said pressure pad has a gradient of porosity.

CLAIM 9. A method for operating a high pressure electrochemical cell, comprising:

a) introducing a low pressure fluid to a low pressure flow field;

b) reacting said low pressure fluid on a low pressure electrode adjacent to and in fluid communication with the low pressure flow field to form ions which migrate across a membrane to a high pressure electrode;

c) forming a high pressure fluid having a pressure exceeding 1,000 p.s.i. greater than the pressure of said low pressure fluid, at the high pressure electrode; and

d) passing said high pressure fluid through a high pressure flow field disposed in intimate contact with an electrically conductive pressure pad.

CLAIM 10. A method for operating a high pressure electrochemical cell as in Claim 9, wherein said pressure pad maintains substantially uniform pressure on said high pressure flow field.

CLAIM 11. A method for operating a high pressure electrochemical cell as in any of Claims 9-10, further comprising operating at pressures exceeding 2,000 p.s.i.

CLAIM 12. A method for operating a high pressure electrochemical cell as in any of Claims 9-11, wherein said pressure pad comprises a support material and an electrically conductive material.

CLAIM 13. A method for operating a high pressure electrochemical cell as in any of Claims 9-12, further comprising operating at pressures exceeding 5,000 p.s.i.

CLAIM 14. A method for operating a high pressure electrochemical cell as in any of Claims 9-13, wherein said pressure pad comprises one or more layers of conductive material interwoven with an elastomer, said layers each having a porosity.

CLAIM 15. A method for operating a high pressure electrochemical cell as in any of Claims 9-14, wherein said pressure pad comprises a fluorosilicone, fluoroelastomer, or combinations thereof.

CLAIM 16. A method for operating a high pressure electrochemical cell as in any of Claims 9-15, wherein said pressure pad comprises steel, nickel, cobalt, carbon, refractory metal, precious metal, or a mixture or alloy thereof.

CLAIM 17. A method for operating a high pressure electrochemical cell as in any of Claims 9-16, wherein said pressure pad has a gradient of porosity.

CLAIM 18. A method for operating a high pressure electrochemical cell, comprising:

a) introducing a high pressure fluid having a pressure exceeding about 100 p.s.i. to a high pressure flow field disposed in intimate contact with an electrically conductive pressure pad;

b) reacting said high pressure fluid on a high pressure electrode adjacent to and in fluid communication with the high pressure flow field to form ions which migrate across a membrane to a low pressure electrode;

c) forming a low pressure fluid at the low pressure electrode; and

d) passing said low pressure fluid through a low pressure flow field.

CLAIM 19. A method for operating a high pressure electrochemical cell as in Claim 18, wherein said pressure exceeds about 500 p.s.i.

CLAIM 20. A method for operating a high pressure electrochemical cell as in any of Claims 18-19, wherein said pressure exceeds about 1,000 p.s.i.

CLAIM 21. A method for operating a high pressure electrochemical cell as in any of Claims 18-20, wherein said pressure pad comprises one or more layers of conductive material interwoven with an elastomer, said layers each having a porosity.

CLAIM 22. A method for operating a high pressure electrochemical cell as in any of Claims 18-21, wherein said pressure pad comprises steel, nickel, cobalt, carbon, refractory metal, precious metal, or a mixture or alloy thereof.

CLAIM 23. A method for operating a high pressure electrochemical cell as in any of Claims 18-22, wherein said pressure pad comprises a fluorosilicone, fluoroelastomer materials, or combinations thereof.

CLAIM 24. A method for operating a high pressure electrochemical cell as in any of Claims 18-23, wherein said pressure pad has a gradient of porosity.

CLAIM 25. A method for operating a high pressure electrochemical cell as in any of Claims 18-24, wherein the high pressure field operates at above 2000 p.s.i.

CLAIM 26. A method for operating a high pressure electrochemical cell, comprising:

a) introducing a first high pressure fluid having a pressure exceeding about 100 p.s.i. to a high pressure flow field disposed in intimate contact with an electrically conductive pressure pad;

b) migrating at least a portion of said first high pressure fluid from a high pressure electrode, across a membrane, to a low pressure electrode;

c) reacting said first high pressure fluid on said low pressure electrode to form ions which migrate across said membrane to said high pressure electrode;

d) forming a second high pressure fluid at said high pressure electrode; and

e) passing said second high pressure fluid through said high pressure flow field.

CLAIM 27. A method for operating a high pressure electrochemical cell as in Claim 26, wherein said pressure pad comprises one or more layers of conductive material interwoven with an elastomer, said layers each having a porosity.

CLAIM 28. A method for operating a high pressure electrochemical cell as in any of Claims 26-27, wherein said pressure pad has a gradient of porosity.

CLAIM 29. A method for operating a high pressure electrochemical cell as in any of Claims 26-28, wherein the high pressure field operates at above 2000 p.s.i.

CLAIM 30. A method for operating a high pressure electrochemical cell as in any of Claims 26-29, wherein said pressure pad comprises steel, nickel, cobalt, carbon, refractory metal, precious metal, or a mixture or alloy thereof.

CLAIM 31. A method for operating a high pressure electrochemical cell as in any of Claims 26-30, wherein said pressure pad comprises a fluorosilicone, fluoroelastomer, or combinations thereof.

CLAIM 32. An electrochemical cell pressure pad, comprising one or more layers of conductive material interwoven with an elastomer, said layers each having a porosity.

CLAIM 33. An electrochemical cell pressure pad as in Claim 32, wherein said pressure pad comprises steel, nickel, cobalt, carbon, refractory metal, precious metal, or a mixture or alloy thereof.

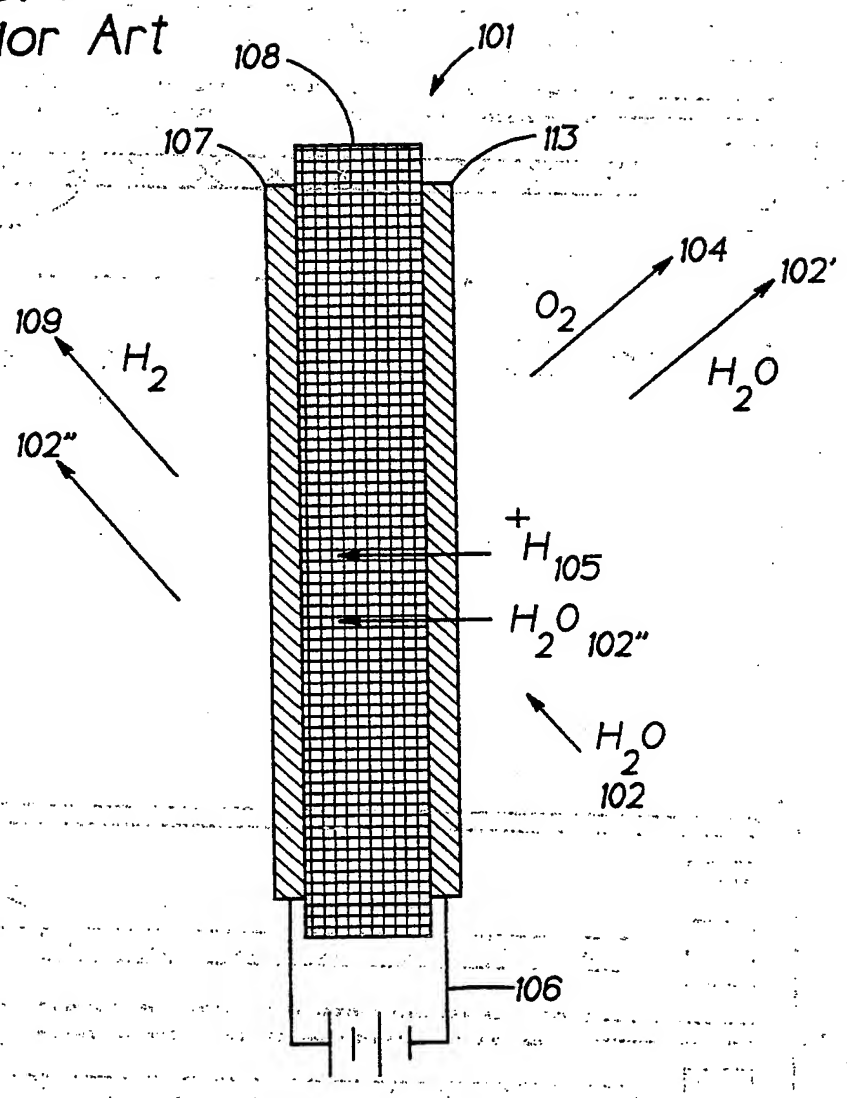
CLAIM 34. An electrochemical cell pressure pad as in any of Claims 32 and 33, wherein said pressure pad comprises a fluorosilicone, fluoroelastomer, or combinations thereof.

CLAIM 35. An electrochemical cell pressure pad as in any of Claims 32-34, wherein said pressure pad has a gradient of porosity.

CLAIM 36. An electrochemical cell pressure pad as in Claim 35, wherein said layers of differing porosity form said gradient.

CLAIM 37. An electrochemical cell pressure pad as in any of Claims 32-36, wherein the high pressure field operates at above 2000 p.s.i.

FIG. 1
Prior Art



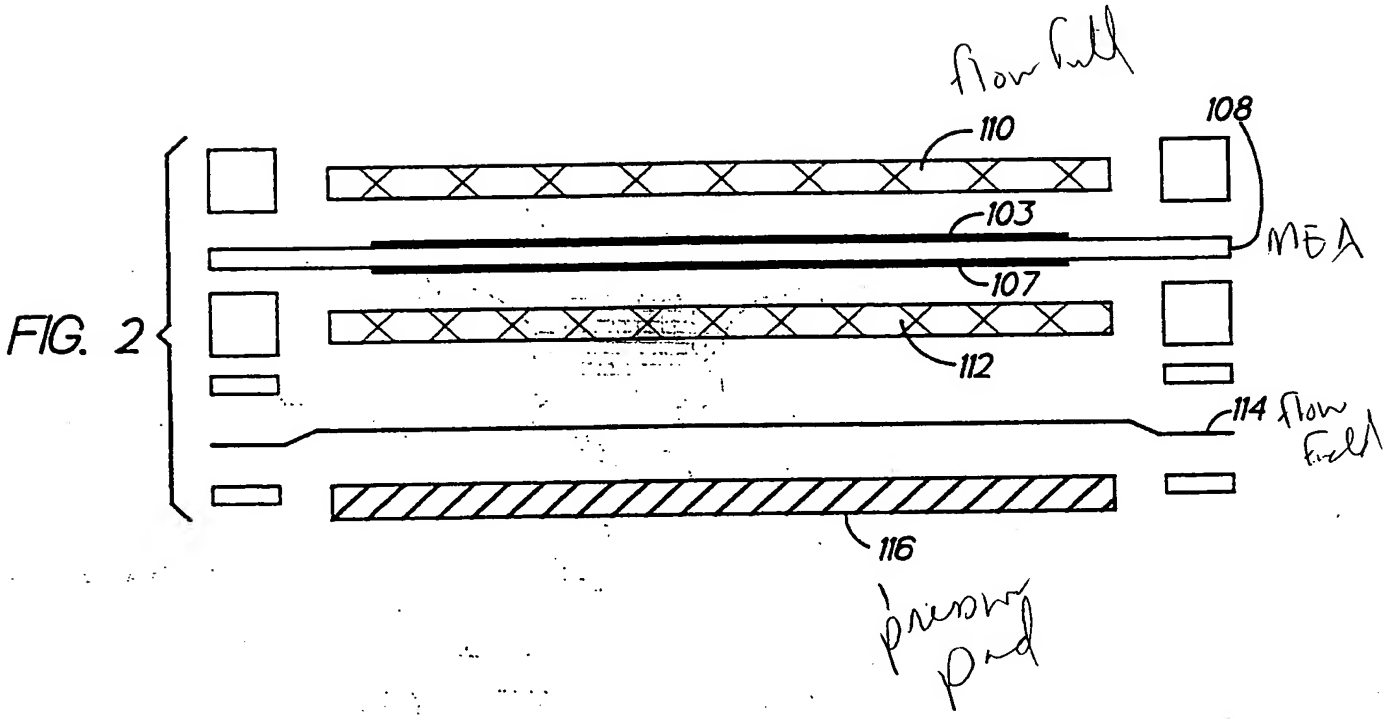

flow field
108
110
103
MEA
107
112
114 flow field
116
previous pad

FIG. 2

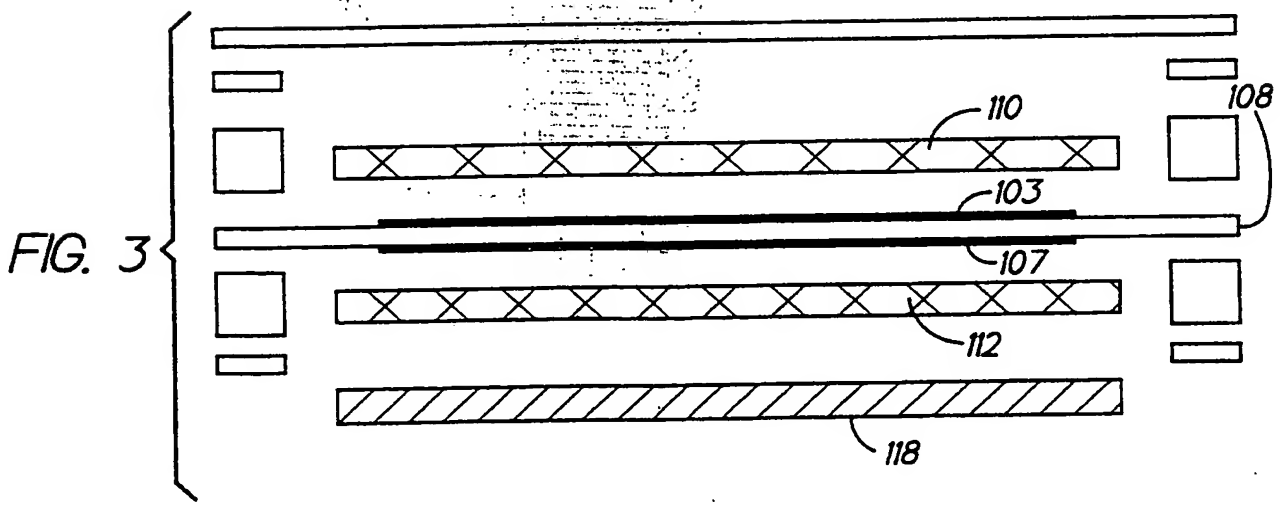
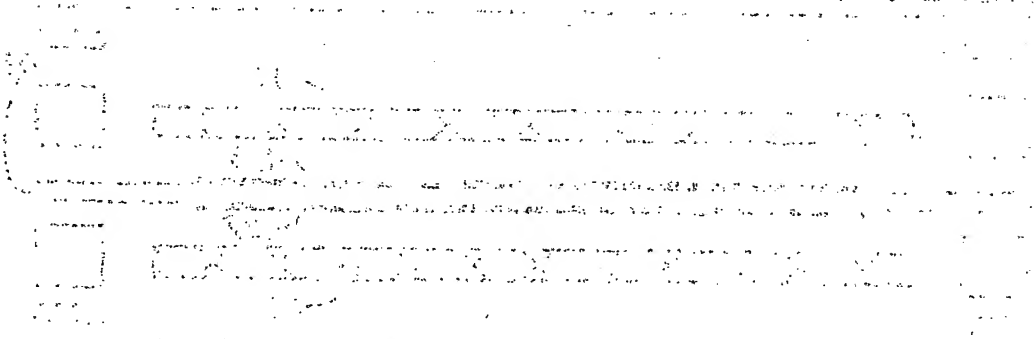

110
108
103
107
112
118

FIG. 3



PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : C25B 9/00, H01M 8/02, 8/10, 8/24 — A3

(11) International Publication Number: WO 00/39362

(43) International Publication Date: 6 July 2000 (06.07.00)

(21) International Application Number: PCT/US99/26509

(22) International Filing Date: 11 November 1999 (11.11.99)

(30) Priority Data:

60/114,559	31 December 1998 (31.12.98)	US
09/413,782	7 October 1999 (07.10.99)	US

(71) Applicant: PROTON ENERGY SYSTEMS, INC. [US/US]; 50 Inwood Road, Rocky Hill, CT 06067 (US).

(72) Inventors: SHIEPE, Jason, K.; 90 Ridgefield Drive, Middletown, CT 06457 (US). DRISTY, Mark, E.; Apartment 107, 141 John Olds Drive, Manchester, CT 06040 (US). MOLTER, Trent, M.; 14 Harvest Lane, Glastonbury, CT 06033 (US). MOULTHROP, Lawrence, C., Jr.; 244 Carriage Way, Windsor, CT 06095 (US).

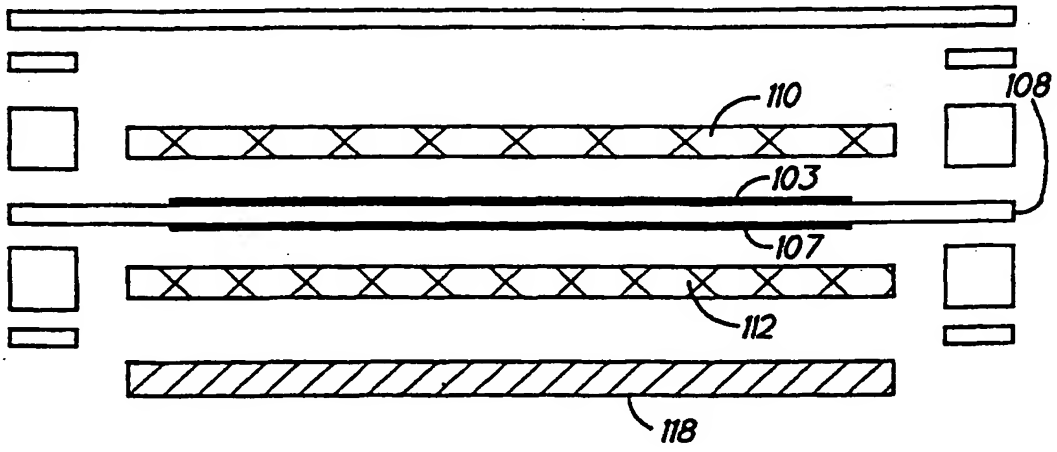
(74) Agent: CURBELO, Pamela, J.; Cantor Colburn LLP, 88 Day Hill Road, Windsor, CT 06095 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(88) Date of publication of the international search report:
16 November 2000 (16.11.00)

(54) Title: MEANS OF MAINTAINING COMPRESSION OF THE ACTIVE AREA IN AN ELECTROCHEMICAL CELL



(57) Abstract

The present invention relates to a unique electrochemical cell stack which employs an electrically conductive pressure pad. The pressure pad is composed of material compatible with the electrochemical cell environment and is disposed on the high pressure side of the membrane assembly, in intimate contact with the high pressure side screen pack.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

INTERNATIONAL SEARCH REPORT

Int. Jonal Application No
PCT/US 99/26509

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C25B9/00 H01M8/02 H01M8/10 H01M8/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01M C25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 40537 A (UNITED TECHNOLOGIES CORP) 17 September 1998 (1998-09-17) page 8, line 18 -page 9, line 22 figure 1	1,32
A	WO 98 23794 A (UNITED TECHNOLOGIES CORP) 4 June 1998 (1998-06-04) page 14, line 19 -page 15, line 9 page 16, line 26 -page 17, line 26	1,6,33
A	US 5 466 354 A (LEONIDA ANDREI ET AL) 14 November 1995 (1995-11-14) column 2, line 58 - line 9	1,33,37

-/—

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 July 2000	27/07/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gamez, A

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/US 99/26509

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 009 968 A (KATZ MURRAY ET AL) 23 April 1991 (1991-04-23) figure 1 column 2, line 12 - line 40 column 3, line 4 - line 13 claim 1	1,32

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 99/26509

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9840537 A	17-09-1998	US 5942350 A	24-08-1999
		EP 0966556 A	29-12-1999
WO 9823794 A	04-06-1998	US 6037075 A	14-03-2000
		EP 0895548 A	10-02-1999
US 5466354 A	14-11-1995	US 5366823 A	22-11-1994
		DE 69317125 D	02-04-1998
		DE 69317125 T	18-06-1998
		EP 0674811 A	04-10-1995
		JP 7509756 T	26-10-1995
		WO 9414204 A	23-06-1994
US 5009968 A	23-04-1991	ES 2025970 A	01-04-1992
		IT 1240979 B	27-12-1993